GETTING THE MOST OUT OF JOB HAZARD ASSESSMENTS

October 18, 2016

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"GENTLEMEN, WE WILL CHASE PERFECTION, AND WE WILL CHASE IT RELENTLESSLY, KNOWING ALL THE WHILE WE CAN NEVER ATTAIN IT. BUT ALONG THE WAY, WE SHALL CATCH EXCELLENCE."

— VINCE LOMBARDI JR.

OUTLINE

- Background
- Job Hazard Assessments
- ANSI Z590.3 (2011) Prevention Through Design
- HAZOP
- Excel-based JHA Tool
- Conclusion

JOB HAZARD ASSESSMENT

- 29 CFR 1910.132(d) & Subpart I Appendix B
- Appendix B Steps:
 - Survey
 - Sources
 - Organize & analyze data
 - Mitigation
 - Reassessment

TYPICAL JHA [SUBPART I, APPENDIX B]

Source	Assessment of Hazard	Protection
IMPACT – Chipping, grinding, masonry work, woodworking, sawing, drilling	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Spectacles with side protection, goggles, face shields. For severe exposures use face shield.
HEAT – Furnace operations,	Hot sparks	Face shield over goggles.
pouring, casting, hot dipping,	Splash from molten metals	Screen/reflective face shields
and welding.	High temperature exposure	Screen/reflective face shields
DUST – Woodworking, buffing, general dusty conditions	Nuisance dust	Goggles, eyecup and cover types.

LIMITATIONS

- No discussion of root causes (e.g., culture, training, values, etc.) other than the immediate hazard.
- Avoids discussion of risk (severity + probability).
- Doesn't evaluate residual risk.
- Assessment is often limited to PPE controls.

Avoids the discussion with management what level of

risk is acceptable.

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IS THERE A DIFFERENCE?



RISK ASSESSMENT BENEFITS

- Effectively utilizes limited resources.
- Allows for prioritization of risks.
- Allows non-experts to quickly review exposure risks of new operations.
- Provides a transparent method of evaluation and control recommendation.
- Globally, allows risk determinations where otherwise wouldn't exist.



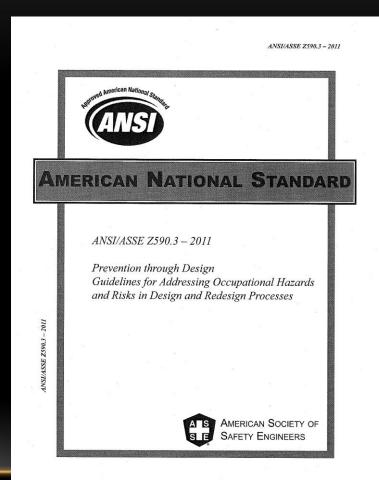
STEPHANIE KLEIN-DAVIS | The Roanoke Times

TYPES OF RISK ASSESSMENTS

- Failure Mode & Effects Analysis (FMEA)
- Probabilistic Risk Assessment
- Fault Tree Analysis
- ANSI/ASSE Z590.3 (2011) PtD
- Bayesian Theory
- REACH Exposure Scenarios
- Control Banding
- Hazard & Operability Study (HAZOP)

ANSI/ASSE Z590.3 (2011) PREVENTION THROUGH DESIGN

- Voluntary consensus standard.
- Strives to eliminate, reduce or control hazards throughout a product or process life cycle.
- Greatest benefit is early in the life cycle.
- Complements the ANSI/AIHA Z10 Occupational Health & Safety Management Systems standard.



ANSI/ASSE Z590.3 PROCESS

- 1. Seek management approval of process/matrix.
- 2. Establish scope, timing, limits of the analysis.
- Identify hazards, severity of consequences, and probability.
- 4. Define the initial risk (uses 2x2 matrix)
- 5. Select and implement risk reduction method(s).
- 6. Assess residual risk
- 7. Document and follow-up.

IDENTIFY HAZARDS

- Susceptible to expertise and judgment.
- Standardize process by:
 - Hazard checklists.
 - Interviewing/involving engineers or operators.
 - Considering non-typical operating conditions.
 - Evaluating chemical, biological, physical hazards.
 - Considering failure modes:
 - What can go wrong, causes, effects, frequency, severity, etc.

ASSESS SEVERITY

- Base on worst credible (vs. conceivable) consequence.
- Use objective historical data (if available) to tailor category descriptions to the business.
- Consider effects on:
 - Injury number/severity
 - Environmental damage
 - Productivity losses
 - Health effects
 - Others

SEVERITY CATEGORIES & VALUES

- Catastrophic: fatalities, permanent total disability, system loss, lasting damage, exposures usually > OEL.
- Critical: permanent partial / temporary disability, major property damage/loss, exposures sometimes > OEL.
- Marginal: Medical/restricted work, triggers environmental reporting, exposures usually 50 – 99% OEL.
- Negligible: First aid, routine chemical cleanup, exposures usually <10% OEL.
- Insignificant: Inconsequential effects; exposures <1% OEL.

ASSESS PROBABILITY

- Consider frequency, duration, number exposed, etc.
- Relate to an interval such as time, units produced, etc.
- Categories
 - Frequent: Likely to occur repeatedly
 - Probable: Occurs several times
 - Occasional: Occurs intermittently
 - Remote: Could occur, but rare.
 - Improbable: Will not occur.

DEFINE RISK

	Catastrophic	Critical	Marginal	Negligible
Frequent	High	High	Serious	Medium
Probable	High	High	Serious	Medium
Occasional	Serious	Serious	Medium	Low
Remote	Medium	Medium	Medium	Low
Improbable	Low	Low	Low	Low

RISK MITIGATION

Hierarchy of Controls

Avoidance: Prevent risk during design

Eliminate: Eliminate risk after discovery

Substitute: Replace with less risky materials or processes

Engineering Controls: Incorporate engineering controls

Warning: Provide warning systems

Administrative Controls: Develop training, scheduling, oversight, etc.

Personal Protective Equipment: Administer PPE program [29 CFR 1910.132 et al]

HAZARD & OPERABILITY STUDY (HAZOP)

- Planned/existing process broken into 'nodes'.
- Piping & instrumentation diagram (P&ID) and process flow diagrams used.
- Multidisciplinary team reviews risks qualitatively.
- Guidewords used to prompt review of risks.

	More	Less	None	Reverse
Flow	High flow	Low flow	No flow	Reverse flow
Pressure	High pressure	Low pressure	No pressure	
Temp	High temp	Low temp		

Deviations of design intent are then determined.

HAZOP COLUMN HEADINGS

Before Risk Reductions:

- Node
- Deviation (via guide words)
- Cause
- Consequence
- Risk (Severity+ Likelihood)
- Effective Safeguards

After Risk Reductions:

- Safeguards
- Recommendations
- Responsibility
- Status
- Risk (Severity+Likelihood)

			Pote	Potential Risk						Safeguards					Measure	Safeguards		
Deviation	Cause	Consequence	Foll	SHUGH	Non	Task	Mate Man	C	F #:	Set Point	Actor	Safety	C4-4	Responsible	Category	Saleguards	Recommendation	
			Р	S	R		Main idea Sensor		Function	Set Point	Actor	Position	Status	Responsible	Category	Description		
1. High Pressure																		
2. Low Pressure																		
3. Vacuum																		
4. High Level																		
5. Low / No Level																		

Node	Deviation	Cause	Consequence	Before	Risk Red	duction	Effective Safeguards	Recommendations	Responsibility	Status	After	Risk Red	uction
Node	Deviation	Cause	Consequence	S	L	RR	Ellective Ballegualus	Recommendations	Responsibility	Status	S	L	RR
1.													
2.													
3.													
4.													
3. 4.												_	

SIMILARITIES

JHA	Z590.3	HAZOP
Define /prioritize job task steps	Define process / equipment	Define Nodes
Observations / SOPs	Equipment specs / P&ID's	Process Flow / P&ID's
Multidisciplinary team	Multidisciplinary team	Multidisciplinary team
List of Hazards & Results	Checklists & Failure Modes	Use Guide Words
Severity + Probability + Exposure	Severity + Probability	Severity + Probability
Danger Value + Danger Index	High/Serious/Medium/Low	Risk Rating
Determine corrective action	Determine corrective action	Determine corrective action

Job or Position Description:										Bldg/Department:						
Equipment Name: (Asset # if available)										Evaluator(s) Name:		0.0000000000000000000000000000000000000			:::::::::::::::::::::::::::::::::::::::	
Date Completed:										HSE Review Signature & Date JHA ID#						
Required PPE:										(HSE Completes)						
•										Engineering Control Recommendations:						
Task	Hazard Category		Result		Hazard Severity	Risk Probability	Exposure Level	Danger Value (Max. 100)	Danger Index (1,2,3,4)	Action to Reduce Risk ¹	Residual Hazard	Residual Risk Probability	Exposure	Residual Danger Value (Max. 100)	Residual Danger Index	Further action Notes
Call for help	No Hazard	▼ No	Hazard	•	1	1	2	3	1	Nisk	1	1	2	3.125	1	Notes
Barricade affected area	No Hazard	_	Hazard	-	1	1	2	3	1		1	1	2	3.125	1	
Obtain BBP & First Aid kits	No Hazard	=	Hazard	•	1	1	2	3	1		1	1	2	3.125	1	
Don PPE from BBP kit	No Hazard	▼ No	Hazard	~	1	2	2	6	1	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
Treat and/or remove employee	Biohazard Expos	▼ Inf	fection	•	4	2	3	38	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	3	9.375	1	
Apply available absorbents to bodily fluids	Biohazard Expos	▼ Inf	fection	•	4	3	3	56	3	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	3	14.0625	1	
Collect absorbent into biohazard waste bags	Biohazard Expos	▼ Inf	fection	•	4	3	4	75	4	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
Repeat application and collection of absorbents as necessary to clean up bulk fluid.	Biohazard Expos	▼ Inf	fection	~	4	3	4	75	4	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
Apply disinfection product, allowing for adequate contact time.	Biohazard Expos	▼ Inf	fection	•	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
	Chemical Exposu	▼ De	rmatitis	•	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock,	1	2	2	6.25	1	
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	Task		Hazard Category		Result		Hazard	Risk Probability	Exposure Level	Danger Value (Max. 100)	Danger Index (1,2,3,4)	Action to Reduce Risk ¹	Residual Hazard Severity	Residual Risk Probability	Residual Exposure Level	Residual Danger Value (Max. 100)	Residual Danger Index	Further action Notes
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Call f	r help	_	No Hazard	_	INO FIAZAFO		1	1	2	3	1		1	1	2	3.125	1	
Barrica	ade affected ar		No Hazard	┪	No Hazard		1	1	2	3	1		1	1	2	3.125	1	
Obt lin	BBP & First /	id	No Hazard	▾	No Hazard	▼	1	1	2	3	1		1	1	2	3.125	1	
Do P	PE from BBP		No Hazard	▼	No Hazard	▼	1	2	2	6		Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.		2	2	6.25		
	and/or remove		diohazard Expos	V	Infection	-	4	2	3	38	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	3	9.375	1	
Apoly	available bents to bodily		Biohazard Expos		Infection	V	4	3	3	56	3	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	3	14.0625	1	
Co ec	t absorbent int zard waste bag	ŀ	Biohazard Expo	▼	Infection	V	4	3	4	75		Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
collect	at application a tion of absorbe cessary to clea lk fluid.	ts	Biohazard Expos	▼	Infection	▼	4	l i	et	St	ep:	eyewear, es, smock, nt exposure.	1	3	4	18.75	1	
Apply produ	disinfection		Biohazard Expos	▼	Infection	V	4	2	3 L	25		eyewear, es, smock, booties to prevent exposure.	1	2	2	6.25	1	
	\		Chemical Exposu	V	Dermatitis	—	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock,	1	2	2	6.25	1	
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				V		T				0	1					0	1	

											5	5	5	Residual	Residual	
	Hazard				Hazard	Risk	Exposure	Danger Value	Danger Index	Action to Reduce	Residual	Residual Risk	Residual Exposure	Danger Value	Danger Index	Further action
Task	Category		Result			Probability	Level	(Max. 100)	(1,2,3,4)	Reduce Risk ¹	Hazard Severity	Probability	Level	(Max. 100)		Notes
Task	Category		Result	$\overline{}$	Severity	Probability	Level	(IVIAX. 100)	(1,2,3,4)	RISK	Seventy	Probability	Level	(IVIAX. 100)	(1,2,3,4)	Notes
Call for help	No Hazard	•	No Hazard		1	1	2	3	1		1	1	2	3.125	1	
Barricade affected are	No Hazard	▼	No Hazard	7	1	1	2	3	1		1	-1	2	3 125	1	
Obtain BBP & First Adkits	No Hazard	▼	No Hazard	Ŧ	1	1	2	3	1	Calasi					1	
	No Hazard	•	No Hazard	▼						Select		122	Zal			
Don PPE from BBI kit					1	2	2	б	1						1	
Treat and/or remore employee	Biohazard Expos	V	Infection	▼	4	2	3	38	2	& Res	sul	t fı	ror	m	1	
Apply available absorbents to bod ly fluids	Biohazard Expos	~	Infection	-	4	3	3	56	3						1	
Collect absorbent into biohazard waste bigs	Biohazard Expo	~	Infection	▼	4	3	4	75	4	drop.	-do	WC	ns.	5	1	
Repeat application and collection of absorb ints as necessary to clean	Biohazard Expos	~	Infection	▼						Wear protective eyewear, faceshield, gloves, smock,						
up bulk fluid.					4	3	4	75	4	booties to prevent exposure.	1	3	4	18.75	1	
Apply disinfection product, allowing for adequate contact time.	Biohazard Expos	~	Infection	1	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
	hemical Exposu	—	Dermatitis	T	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock,	1	2	2	6.25	1	
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	Hazard				Hazard	Ris	k l	Exposure	Danger Value	Danger Index	Action to Reduce	Residual Hazard	Residual Risk	Residual Exposure	Residual Danger Value	Residual Danger Index	Further action
Task	Category		Result		Severity		bility		(Max. 100		Risk ¹		Probability		(Max. 100)		Notes
Call for help	No Hazard	•	No Hazard	Ŧ	1	1		2	3	1		1	1	2	3.125	1	
Barricade affected area	No Hazard	▾	No Hazard	F	1	1		2						2	3.125	1	
Obtain BBP & First Aid kits	No Hazard	T	No Hazard	F	1	1		2			Accian			2	3.125	1	
	No Hazard	▼	No Hazard	v							7331911						
Don PPE from BBP kit					1	2		2					2	2	6.25	1	
Treat and/or remove employee	Biohazard Expos	•	Infection	~	4	,		3	4	l j	Assign Hazard		,	3	9.375	1	
Apply available	Biohazard Expos	▼	Infection	~	4	R		3						3	14.0625	1	
	Biohazard Expo	▼	Infection	~	4	3		4		<u> </u>	Severity			4	18.75	1	
Repeat application and collection of absorbents	Biohazard Expos	▼	Infection	~		T					Wear protective eyewear,						
as necessary to clean up bulk fluid.				١	4	3		4	75	4	faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
Apply disinfection	Biohazard Expos	▼	Infection	1	4	2		2	25	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
	Chemical Exposu	•	Dermatitis	7	4	2		2	25	2	Wear protective eyewear, faceshield, gloves, smock,	1	2	2	6.25	1	
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DEFINE SEVERITY OF HAZARD

Best

Worst

- Negligible (1): Minor first aid w/ no SIF potential; minor irritation; OEL >500ppm or 5 mg/m³; FP > 200F; little property damage (\$500 \$1,999).
- Minor (2): Reversible injury/illness (lacerations, contusions, tendonitis, strong irritants, etc.); low SIF potential; OEL >250ppm or >2.5 mg/m³; FP 140F 200F: Property damage \$2k \$20K.
- Moderate (3): Severe reversible (fractures, strains, sprains, carpal tunnel, sensitization, corrosives) usually w/ lost days; some SIF potential; OEL >10ppm or 0.1 mg/m³; FP 100F 140F; Property damage (\$20k \$200K).
- Major (4): Catastrophic (death, amputations, hearing loss, 3rd degree burns, carcinogens, blindness); High SIF potential; OEL <10ppm or >0.1 mg/m³; FP <100F; Property damage > \$200K.

BASED JHA FORMAT

									Danger	Danger	Action to	Residual	Residual	Residual	Residual Danger	Residual Danger	
	Hazard				Hazar	d Risk	Expo	osure	Value	Index	Reduce	Hazard	Risk	Exposure	Value	Index	Further action
Task	Category		Result		Severit	Probability	/ Le	evel	(Max. 100)	(1,2,3,4)	Risk ¹	Severity	Probability	Level	(Max. 100)	(1,2,3,4)	Notes
Call for help	No Hazard	~	No Hazard	▼	1	1	1	2	3	1		1	1	2	3.125	1	
Barricade affected area	No Hazard	▼]	No Hazard	▼	1	1		2	3			Ь.	_ 1	2	3.125	1	
Obtain BBP & First Aid kits	No Hazard	▼	No Hazard	$\overline{}$	1	1	:	2	3	1 A	ssign	KI	SK	2	3.125	1	
	No Hazard	▼	No Hazard	▼							nacesineia, gioves, sinock,						
Don PPE from BBP kit	Ť				1	2		£	6	1	booties to prevent exposure.	1	2	2	6.25	1	
Treat and/or remove employee	Biohazard Expos	▼	Infection	▼		2		3	38	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	3	9.375	1	
Apply available	Biohazard Expos	▼	Infection	▼		3		3	56	3	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	3	14.0625	1	
	Biohazard Expo	▼	Infection	-		3		4	75		Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
Repeat application and collection of absorbents as necessary to clean	Biohazard Expos	▼	Infection	-			П				Wear protective eyewear, faceshield, gloves, smock,						
up bulk fluid.				-	4	3	+ -	4	75		booties to prevent exposure.	1	3	4	18.75	1	
Apply disinfection product, allowing for adequate contact time.	Biohazard Expos	▼	Infection	▼	4	2	 	2	25		Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
	Chemical Exposu	~	Dermatitis	-	4	2		2	25		Wear protective eyewear, faceshield, gloves, smock,	1	2	2	6.25	1	
		V		₹[0	1					0	1	
		V		▼					0	1					0	1	

DEFINE PROBABILITY

Best

- Unlikely (1): Low frequency of occurrence (several times per month or year) or will not occur. Reliable and effective engineering controls in place.
- Occasional (2): Medium frequency of occurrence (several times per week). Usually reliable and effective administrative controls or barriers in use.
- Likely (3): High frequency of occurrence (several times per day). Behavior-based controls in place which are often variable.

Worst

• Frequently (4): In constant occurrence throughout the day or during operation of equipment. Use of PPE, signs, training in place. Poor employee commitment.

								7		D	Antinoto	D	D	D '- 1 1	Residual	Residua	
Hazard				Hazard	Risk	Expos	SUFO	Danger Value	Danger Index	Action to Reduce	Residual Hazard	Residual Risk	Residual Exposure		Danger Index	Further action	
Task Category Result					Probabi			Max. 100)	(1,2,3,4)	Risk ¹		Probability		(Max. 100			
		_	No Hazard	—			Í		_	(1,=,=,1)				2			
Call for help	No Hazard	_	IVO Flazaru	_	1	1	2	-	3	1		1	1	2	3 125	1	
Dunicade directed area	No Hazard	▾	No Hazard	•	1	1	2		3	1	Λ				125	1	
Obtain BBP & First Aid kits	No Hazard	▼	No Hazard	▼	1		2		3	1	AS:	SIC	nk		125	1	
	No Hazard	▼	No Hazard	▼)				
Don PPE from BBP kit					1		2			1	Evn			\bigcirc	25	1	
Treat and or remove	Biohazard Expos	▼	Infection	▼					200		As: Exp	US	ur	C	275		
employee Apply available		_		_	4	<u> </u>	3		38	2					375	1	
absorbents to bodily fluids	Biohazard Expos	▼	Infection	•	,		3		50	3	Wear protective eyewear, faceshield, gloves, smock,		3	3	44.0005		
TIUIOS		_		_	4	_	- 3		56		booties to prevent exposure. Wear protective eyewear,	1	3	3	14.0625	1	
Collect absorbent into biohazard waste bags	Biohazard Expo:	▼	Infection	_	4		4		75	4	faceshield, gloves, smock, booties to prevent exposure.	1	3	A	18.75	1	
Repeat application and		=		_			+ -		- /-		booties to prevent exposure.	<u> </u>		1	10.75		
collection of absorbents	Biohazard Expos	▼	Infection								Wear protective eyewear,						
as necessary to clean up bulk fluid.					4	3	4		75		faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
Apply disinfection											Wear protective eyewear,						
product, anothing to	Biohazard Expos	蟴	Infection	•	4	2	2		25		faceshield, gloves, smock,	1	2	2	6.25	1	
adequate contact time.					4	2	2		25		booties to prevent exposure. Wear protective eyewear,	1	2	2	6.25	1	
	Chemical Exposu	▼]	Dermatitis	▼	4	2	2		25		faceshield, gloves, smock,	1	2	2	6.25	1	
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		V		₹					0	1					0	1	

DEFINE EXPOSURE LEVEL

Best

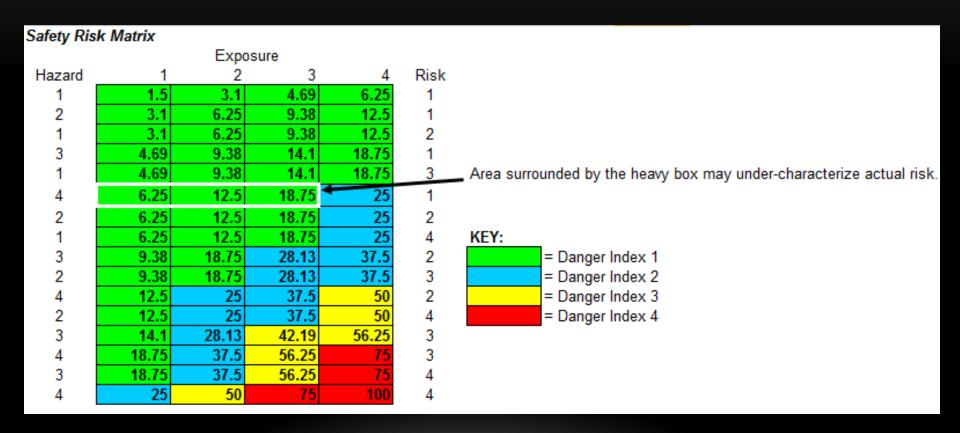
Worst

- Negligible (1): No people exposed.
- Minor (2): 1 4 people exposed, but not necessarily concurrently.
- Moderate (3): 5 9 people exposed, but not necessarily concurrently.
- Major (4):

 > 10 people exposed, but not necessarily concurrently.

Hazard					Hazard	Risk	Exposu	ıre	Danger Value	Danger Index	Action to Reduce	Residual Hazard	Residual Risk	Residual Exposure	Residual Danger Value	Residual Danger Index	Fı	rther action
Task	Task Category Result				Severity	Probability	Level		(Max. 100)	(1,2,3,4)	Risk ¹	Severity	Probability	Level	(Max. 100)	(1,2,3,4)		Notes
Call for help	No Hazard	•	No Hazard	V	1	1	2	Ц	3	1		1	1	2	3.125	1		
Darricade allected area	No Hazard	▼	No Hazard	▼	1	1	2		3	1								
Obtain BBP & First Aid kits	No Hazard	▼	No Hazard	▼	1	1	2		3	1				n		r		
	No Hazard	▼	No Hazard	•							Wear protective eyewear, fac shield, gloves, smock			1116	gei			
Don PPE from BBP kit					1	2	<u> </u>		6	1	boolies to prevent exposu	_		_				
Treat and/or remove employee	Biohazard Expos	▼	Infection	▼	4	2	3		38	2	We contective eyewear, face sheld, sloves, smoot booles to preven exposu		Value &					
Apply available absorbents to bodily	Biohazard Expos	▼	Infection	~			Ĭ				Wear protective eyewear							
fluids Collect absorbent into biohazard waste bags	Biohazard Expo	-	Infection	▼]	4	3	3		56 75	3	boo es to prevent exposu We r protective eyewear, face shield, gloves, smock boo ies to prevent exposu	Ind	ndex Auto-					
Repeat application and collection of absorbents	Biohazard Expos	-	Infection	▼]	4	3		Ī	15	+	Wear protective eyewear,	C	calculated					
as necessary to clean up bulk fluid.				4	3	4		75	4	faceshield, gloves, smock booties to prevent exposu			U II					
Apply disinfection product, allowing for adequate contact time.	Biohazard Expos	▼	Infection	▼]	4	2	2		25	2	Wear protective eyewear, faceshield, gloves, smock, boties to prevent exposure.	1	2	2	6.25	1		
	Chemical Exposu	-	Dermatitis	—	4	2	2	1	25	2	Vear protective eyewear, faceshield, gloves, smock,	1	2	2	6.25	1		
		V		V					0	1					0	1		
		V		▼					0	1					0	1		

RISK ASSESSMENT MATRIX



DANGER INDEX VALUES

- Level 1: Low Risk/Controls
 - continue to maintain/manage risk.
- Level 2: Moderate Risk/Controls
 - use/budget engineering controls.
- Level 3: High Risk/Controls
 - use/budget containment and/or redesign.
- Level 4: Severe Risk/Controls
 - stop operations and consult an IH.

GUIDANCE SHEET

Separate sheet for each Danger Index.

This control summary sheet is intended to provide general control strategies for the Danger Index calculated by the Risk Assessment Tool. For additional details, consult product MSDS, site operating procedures, Job Hazard Analysis (JHA), or contact your site EHS

Health Danger Index 1: Low risk but could be nearing levels of concern. Use good personal hygiene and PPE if desired. Conduct monitoring if desired.

Safety Danger Index 1: Relatively low importance / low action priority. Continue to maintain and re-address if process changes.

SUMMARY: Chemicals and processes falling in this Danger Index present minimal hazards to those exposed. Job tasks in this category still present opportunity for injury so employees must follow established procedures and training. Job tasks in this category should be routine, with minimal deviations, unique procedures, or specialized equipment necessary to complete the task. Representative air/noise monitoring is recommended to confirm employee exposures are acceptable.

DO's

- Be sure you understand the health and safety hazards of the chemicals you are using.
- Follow established procedures and training when conducting a job task. If you aren't sure about how to do a job, consult your supervisor.
- Always wash your hands after using chemicals, especially before eating and using the restroom.
- Make sure there is always good general room ventilation when using any hazardous materials.
- Know what personal protective equipment (PPE) you need for the job before you begin work. This information can be found in site Job Hazard Analysis (JHA's) or by contacting a supervisor.
- Remember, not all chemical gloves protect against exposure to all types of chemicals! Make sure you are using are appropriate gloves by consulting the JHA or your supervisor.
- If you are concerned about your exposures to hazardous materials used at work, be sure to contact your EHS Administrator. has an extensive air monitoring program to ensure that chemical exposures are at safe levels.
- Never attempt to clean up any chemical spill unless it is a very small incidental spill. Special training and equipment is required to clean up larger spills. Report all spills to your supervisor since some spills may be required to be reported to government agencies.
- Make sure you know the location of all emergency equipment before starting a task. This includes safety showers/eyewash, fire extinguishers, first aid kits, and telephones.
- Immediately report signs of leaks, wear or damage to equipment or chemical containers to your supervisor or EHS administrator.

DON'Ts

- Never mix chemicals together unless following a specific written procedure. Many chemicals when mixed together can form poisonous or flammable gases and vapors.
- Never use any chemicals or operate equipment that emits chemicals in a confined space without going through permit entry procedures and the use of air monitoring equipment.
- Avoid eating or drinking in areas where hazardous materials are used.
- Disposable personal protective equipment (PPE) is just that.... disposable. Avoid repeated use of single-use gloves, earplugs, dust masks and other disposable PPE since it loses effectiveness.
- Never dump chemicals down the drain or throw potentially hazardous debris in the trash. If you are not sure how to dispose of a potentially hazardous material, contact your supervisor or EHS Administrator.
- Don't allow new chemicals and equipment to be introduced into the workplace without going through an Environmental, Health & Safety (EHS) review. If it appears the materials, procedures or equipment you are working with has not been reviewed and approved by an EHS administrator, raise the issue with your site management or EHS Administrator.

							-	_		5	5	5	Residual	Residual	
		Hazard		Hazard	Risk	Exposure	Danger Value	Danger Index	Action to Reduce	Residual Hazard	Residual Risk	Residual Exposure	Danger Value	Danger Index	Further action
	Task	Category	Result	Severity			(Max. 100)	(1,2,3,4)	Reduce Risk ¹		Probability		(Max. 100)		Notes
	Tuon	outogory	- Toodit		1 Tobability	20101	(Widst: 100)	(1,2,0,4)	THICK	Coronty	1 TODGOMKY	20101		(1,2,0,4)	110100
Call for					1	2	3	1		1	1	2	3.125	1	
Barrica			م دانه		1	2	3	1		1	1	2	3.125	1	
Obtain kits		Jesc	cribe		1	2	3	1		1	1	2	3.125	1	
Don Pf	٨	otio	n to		2	2	6	~	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
Treat a employ					2	3	38	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	3	9.375	1	
Apply a absorb fluids	Re	duc	e Ri	sk	3	3	56	3	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	3	14.0625	1	
Collect		Dioriazara Expo	zinecoon	4	3	4	75	4	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
collectio	ssary to clean	Biohazard Expos	Infection	4	3	4	75	4	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.		3	4	18.75	1	
Apply di product,	sinfection	Biohazard Expos	Infection	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
		Chemical Exposu ▼	Dermatitis	₹ 4	2	2	25	2	Wear protective eyewear, aceshield, gloves, smock,	1	2	2	6.25	1	
	0	<u> </u>		₹			0	1					0	1	
		▼		-			0	1					0	1	

REDUCING RESIDUAL RISK

Task	Hazard Category		Result		Hazard Severity	Risk Probability	Exposure Level	Danger Value (Max. 100)	Danger Index (1,2,3,4)	Action to Reduce Risk ¹	Residual Hazard Severity	Residual Risk Probability	Residual Exposure Level	Residual Danger Value (Max. 100)	Residual Danger Index (1,2,3,4)	Further action Notes
Call for help	No Hazard		No Hazard	▼	1	1	2	3	1		1	1	2	3.125	1	
Barricade affected area	No Hazard	•	No Hazard	₹	1	1	2	3	1		1	1	2	3.125	1	
Obtain BBP & First Aid kits	No Hazard	₹	No Hazard	₹	1	1	2	3	1		1	1	2	3.125	1	
	No Hazard	V	No Hazard	▼						Wear protective eyewear, faceshield, gloves, smock,						
Don PPE from BBP kit				1	1	2	2	6	1	booties prevent exposure.	1	2	2	6.25	1	
Treat and/or remove employee	Biohazard Expos	•	Infection	•	4	2	3	38	2	Wear potective eyewear, facesheld, gloves, smock, booties to prevent exposure.	1	2	3	9.375	1	
Apply available absorbents to bodily fluids	Biohazard Expos	•	Infection	•	4	3	3	56	3	Wea protective eyewear, factshield, gloves, smock, botties to prevent exposure.	1	3	3	14.0625	1	
	Biohazard Expo-	V	Infection	▼	4	3	4	75	4	Vear protective eyewear, iceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
Repeat application and																

- 1 = Reduction priority based on ALARP (As Low As Reasonably Practical)
 - Eliminate hazard through redesign (for DI = 3 or 4)
 - Substitution using less hazardous methods or materials (for DI = 2 or 3)
 - Incorporation of safety devices or guards (for DI = 2 or 3)
 - Providing warning systems (for DI = 1 or 2)
 - Application of administrative controls (work methods, training, etc.) (for DI = 1 or 2)
 - Providing personal protective equipment (for DI = 1 or 2)

													Residu		
					_	Danger	Danger	Action to		Residual	Residual	Residual	Dange		
	Hazard		Hazard	Risk	Exposure		Index	Reduce		Hazard	Risk	Exposure	Value		Further action
Task	Category	Result	Severity	Probability	Level	(Max. 100)	(1,2,3,4)	Risk ¹		Severity	Probability	Level	(Nax. 1	00) (1,2,3,4)	Notes
Call for help							1			1	1	2	125	1	
Barricade affected are	1		16.0	<i>(</i> i a)			1			1	1	2	3,125	i 1	
Obtain BBP & First Ai kits	ASS	sign	rev	/15	<u>eo</u>		1			1	1	2	3. 25	1	
								Wear protective eyewear, faceshield, glove, sur K							
Don PPE from BBP ki	Ha	zaro	4 [?ie			1	bodies to prevent exposu).	1	2	2	6.25	1	
Treat and/or remove employee							2	Wear protective eyewear, faceshield, gloves, smock booties to prevent exposu		1	2	3	9.3	. 1	
Apply available		Ехро					-	Wear protective evewear.					3.5		
absorbents to bodily		-Vn(7611	ra				faceshield, gloves, smock							
fluids			JOU				3	booties to prevent exposu	e.	1	3	3	14.0	25 1	
								Wear protective eyewear,							
Collect absorbent into								faceshield, gloves, smock,							
biohazard waste bags		Jan	ZID	70			4	booties to prevent exposure	_	1	3	4	18 75	1	
Repeat application and collection of absorbent as necessary to clean		Ranl	ZILI	<u> </u>				Wear protective eyewear, faceshield, gloves, smock,							
up bulk fluid.			4	3	4	75	4	booties to prevent exposure	9.	1	3	4	8.75	1	
	Biohazard Expos	Infection	▼ ,		2	25	2	Wear protective eyewear, faceshield, gloves, smock,	1		2	2	6.25		
adequate contact time.			4	2	2	25		booties to prevent exposure	3.	1	2	2	6.25	1	
	Chemical Exposu ▼	Dermatitis	₹ 4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock,		1	2	2	6.25	1	
	—		-			0	1						0	1	
			₹			0	1						0	1	
						U	1						U		

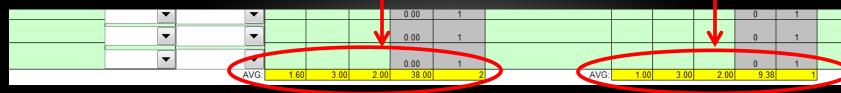
												A - C A -	D	Desided.	D		Residual	Residua	\	
	Hazard				Hazard	Risk	Exposure	Dang Valu		Danger Index		Action to Reduce	Residual Hazard	Residual Risk	Residu Exposu	_	Danger Value	Danger Index	\	Further action
Task	Category		Result			Probability	Level	Max.		(1,2,3,4)		Risk ¹		Probability	Level	_	(Max. 100)	(1,2,3,4)	1	Notes
Tuok		_			Сотолку	robubinty	20101	IVIGA:	100/	(1,2,0,4)		Tuon	Coronky	1 Tobubinty	20101	Π		(1,2,0,4)	т	710100
Call for help	No Hazard	•	No Hazard		1	1	2	3	_	1	1		1	1	2	Ц	3.125	1	Н	
Barricade affected area	No Hazard	▼]	No Hazard		1	1	2	3		1	1		1	1	2		3.125	1	Ц	
Obtain BBP & First Aid kits	No Hazard	▼]	No Hazard		1	1	2	3		1			1	1	2		3.125	1		
	No Hazard	•	No Hazard	▼							We ar	protective eyewear, hield, gloves, smock,								
Don PPE from BBP kit					1	2	2	6		1	bodie	s to prevent exposure.	1	2			6.25	1		
rreat and/or remove	Biohazard Expos	▼	Infection	•	4	2	2	38			faces	protective eyewear, hield, gloves, smock,		2			9.375			
employee Apply evallable				_	4	2	3	38	,			es to prevent exposure. protective eyewear,	1	2	5	-	9.375	1	-	
Apply available absorbents to bodily fluids	Biohazard Expos	▼	Infection	•	4	3	2	56			faces	hield, gloves, smock, es to prevent exposure.	1	3	,		14.0625			
ilulus		=		_	4	3	3	50	,			protective eyewear,		3	H	-	14.0025			
Collect absorbent into biohazard waste bags	Biohazard Expo:	▼	Infection	•	4	3	4	75		4	faces	hield, gloves, smock, es to prevent exposure.	1	3			18.75	1		
Repeat application and collection of absorbents	Biohazard Expos	▼	Infection	\							Wear	protective eyewear,								
as necessary to clean up bulk fluid.					4	3	4	75	,			hield, gloves, smock, s to prevent exposure.	1	3	4		18.75	1		
Apply disinfection product, allowing for	Biohazard Expos	T	Infection	T								protective eyewear, hield gloves, smock,			7					
adequate contact time.	and a suppos			الث	4	2	2	25	;	2		es to prevent exposure.	1	2	2		6.25	1		
	Chemical Exposu	~	Dermatitis	—	4	2	2	25		2	Vear	protective eyewear, hield, gloves, smock,	1	2	2	V	6.25	1	1	
		V		▼				0		1						V	0	1		
		V		▼								Dod					0	1		

Note Reduced
Danger Value &
Danger Index

								_	_					Residual	Residual	
	Hazard				Hazard	Risk	Exposure	Danger Value	Danger Index	Action to Reduce	Residual Hazard	Residual Risk	Residual Exposure	Danger Value	Danger Index	Further action
Task	Category		Result			Probability		(Max. 100)	(1,2,3,4)	Reduce Risk ¹		Probability	Level	(Max. 100)		Notes
					Ocventy	Tobubility	Level	(Max. 100)	(1,2,5,4)	TUSK	Ocventy	Trobubinty	LCVCI	(WILLX: 100)	(1,2,5,4)	140103
Call for help	No Hazard	•	No Hazard	•	1	1	2	3	1		1	1	2	3.125	1	
Dunicade directed area	No Hazard	▼	No Hazard	▼	1	1	2	3	1		1	1	2	3.125	1	
Obtain BBP & First Aid kits	No Hazard	▼	No Hazard	▼]	1	1	2	3	1		1	1	2	3.125	1	
	No Hazard	▼	No Hazard	▼						Wear protective evewear					>	
Don PPE from BBP kit	·				1							2	Ž	6.25	1	
Treat and/or remove employee	Biohazard Expos	▼	Infection	•	4	P	\C t		J 1/	lotes &		2	3	9.375		
Apply available		_		=	4	1							3	9.315		
absorbents to bodily fluids	Biohazard Expos	_	Infection	_	4			`or	mm	nents		3	3	14.0625	1	
Collect absorbent into biohazard waste bags	Biohazard Expo	▼	Infection	▼]	4		4	/O1		booties to prevent exposure.		3	4	18.75	1	
Repeat application and collection of absorbents	Biohazard Expos	V	Infection	V						Wear protective eyewear,						
as necessary to clean up bulk fluid.					4	3	4	75	4	faceshield, gloves, smock, booties to prevent exposure.	1	3	4	18.75	1	
Apply disinfection product, allowing for adequate contact time.	Biohazard Expos	▼	Infection	▼]	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock, booties to prevent exposure.	1	2	2	6.25	1	
	Chemical Exposu	V	Dermatitis	V	4	2	2	25	2	Wear protective eyewear, faceshield, gloves, smock,	1	2	2	6.25	1	
		V		Ţ				0	1	,				0	1	\ /
		V		T				0	1					0	1	

Task	Hazard Category		Result		Haza d Severity	Risk Probability	Exposure Level	Danger Value (Max. 100)	Davger Index (1,2,3,4)		Action to Reduce Risk ¹		Residual Hazard Severity	Residual Risk Probability	Residual Exposure Level	Danger Value (Max. 100)	Residual Danger Ind x (1,2,3,4)	F	urther action Notes
Call for help	No Hazard	•	No Hazard	Ŧ	1	1	2	3	1				1	1	2	3.125	1		
Barricade affected area	No Hazard	•	No Hazard	7	1	1	2	3	1				1	1	2	3.125	1		
Obtain BBP & First Aid kits	No Hazard	V	No Hazard	F	1	1	2	3	1				1	1	2	3.125	1		
	No Hazard	•	No Hazard	T							tective eyewear d, gloves, smoc								
Don PPE from BBP kit					1	2	2	6	1		prevent exposere.	v.	1	2	2	6.25	1		
Treat and/or remove employee	Biohazard Expos	•	Infection	_	4	2	3	38	2	faceshi	tective eyewear d, gloves, smoci o prevent exposule.		1	2	3	9.375	1		
Apply available absorbents to bodily fluids	Biohazard Expos	•	Infection	1	4	3	3	56	3	faceshie	otective eyewear, ld, gloves, smock, o prevent exposure.		1	3	3	14.0625	1		
	Biohazard Expo	-	Infection	•	4	3	4	75	4	V ear pro aceshie	otective eyewear, Id, gloves, smock, o prevent exposure.		1	3	4	18.75	1		
Repeat application and collection of absorbents	Biohazard Expos	•	Infection	•						Wear pro	otective eyewear,								





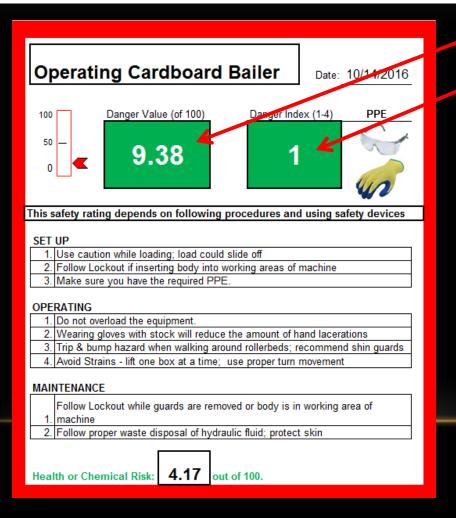
DEVELOP SITE MASTER FILE

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		╡											
•	_				0.00	1					0	1	
	AVG	1.60	3.00	2.00	38.00	2	AVG:	1.00	3.00	2.00	9.38	1	

											7	7	7	Mean Avg	Mean Avg
					TCE				Mean Avg	Residual	Residual				
					Approvar	Mean Avg	Mean Avg	Mean Avg	Danger	Danger	Residual	Residual	Residual	Danger	Danger
Bldg.	Dept.	Supervisor	Job/Position Description	Tracking #	Date	Hazard	Risk	Exposure	Value	Index	Hazard	Risk	Exposure		Index
Shawnee 1	Operations - Sterile Package	George Yiadom-Bi	Entering OAE Values Into Computer	2015-018	11/6/2015	1.60	1.60	2.00	8.75	1.00	1.00	1.00	1.33	1.25	1.00
Shawnee 2	Operations - Sterile Filling		Load & Unload Finn Aqua Autoclave	2015-019	11/16/2015	1.79	2.00	2.00	11.16	1.00	1.08	2.00	2.00	6.25	1.00
Shawnee 2	Operations - Solid Dose Pkg	Bill Moore	Operation of Shawnee 2 Cardboard Bailer	2015-020	11/18/2015	1.93	1.47	2.00	27.00	2.00	1.00	1.00	2.00	3.13	1.00
Shawnee 1	MEU Machine Shop	David Raetzel	Operating Drill Press	2015-021	11/18/2015	1.63	1.00	1.63	4.49	1.00	1.00	1.00	1.00	1.56	1.00
Shawnee 1			Setup of Poly Pack Bundler	2015-022	11/23/2015	2.17	3.00	3.00	65.00	3.00	1.00	2.00	2.00	26.00	2.00
Shawnee 1	Operations - Compounding	Les Wylde	Cleaning RID & Bactine Totes	2015-023	11/24/2015	2.00	2.00	2.00	12.50	1.00	1.00	2.00	2.00	6.25	1.00
Shawnee 1	Operations - Compounding	Les Wylde	Compounding RID in Tank 24311	2015024	11/24/2015	2.52	2.57	2.00	19.43	1.00	1.87	2.30	2.00	13.45	1.00
Shawnee 2	Operations - Sterile Package		Operation of New Jersey Labeler	2015-025	12/8/2015	2.12	2.41	2.00	18.57	1.00	1.06	1.12	1.00	2.02	1.00
Shawnee 1	Technical Development	Romina Schauer	Bioreactor 1	2015-026	12/18/2015	1.65	3.00	3.00	68.00	3.00	1.00	1.48	1.91	4.48	1.00
Shawnee 1	Technical Development	Rex Henry	Bioreactor 2	2015-027	12/18/2015	1.71	2.00	1.86	8.93	1.00	1.43	1.86	1.86	6.25	1.00
Shawnee 1	Technical Development	Romina Schauer	Cell Lysis (<1 kg)	2015-028	12/18/2015	1.25	1.00	2.00	3.91	1.00	1.08	1.00	2.00	3.39	1.00
			Operation of AKTA Process												
Shawnee 1	Technical Development	Rex Henry	Chromatography	2015-029	12/18/2015	1.17	2.00	2.00	7.29	1.00	1.00	2.00	2.00	6.25	1.00
						4.00									
Shawnee I	Lechnical Development	Rex Henry	Operation of Powerfuge Pilot Centrifuges	2015-030	12/21/2015	1.89	3.00	2.00	11.46	2.00	1.00	1.89	2.00	5.90	1.00
Shawnee I	Technical Development	Kex Henry	Operation of Ultrafiltration Skid	2015-031	12/21/2015	1.20	1.00	2.00	3.75	1.00	1.20	1.00	2.00	3.75	1.00
Shawnee 1	PourOn	Les Wylde		2015-032	12/21/2015	2.41	3.00	3.00	71.00	3.00	2.11	1.68	2.00	34.00	2.00
	Operations - Inbound														
Shawnee 1	Compounding	Les Wylde	Compounding RID Shampoo in Room P42	2015-033	12/22/2015	2.45	2.55	2.00	18.61	1.00	1.64	1.95	1.64	9.24	1.00
			TIG Welder Operation in Unconfined												
Shawnee 1	MEU Machine Shop	David Raetzel	Space	2016-001	2/11/2016	1.40	1.00	1.10	83.00	4.00	1.00	2.00	2.00	27.00	1.00
Shawnee 1	MEU Machine Shop	David Raetzel	Spot Welder Operation	2016-002	2/16/2016	1.43	1.00	1.57	3.57	1.00	1.00	1.00	1.00	1.56	1.00
Shawnee 1	MEU Machine Shop	David Raetzel	Passivation of 300-series Stainless Steel	2016-003	2/29/2016	1.65	1.00	1.45	4.14	1.00	1.00	1.00	1.00	1.56	1.00
	Operations - Solid Dose														
Shawnee 2	Compounding	Bill Moore	Performing a Tablet Hardness Test	2016-004	3/4/2016	2.25	3.25	3.00	25.78	2.00	1.00	1.00	1.00	1.56	1.00
	Operations - Solid Dose			2046.005	0.44004.5	2.00	2.00	2.00	47.50		4.00	4.00	4.00		4.00
Shawnee 2	Compounding	Bill Moore	Tablet Press	2016-005	3/4/2016	2.80	2.00	2.00	17.50	1.00	1.00	1.00	1.00	1.56	1.00
Shawnee 1	MEU Machine Shop	David Raetzel	Lathe Operation	2016-006	3/4/2016										

EQUIPMENT POSTING

~	-				0.00	1					0	1	
	_				0.00	1					0	1	
					0.00						,		
•	_				0.00	1					0	1	
	AVG	1.60	3.00	2.00	38.00	2	AVG:	1.00	3.00	2.0	9.38	1	



REASSESSMENT

- Updated every 3 years, if deficient, or if process changes.
- Supervisors are accountable, employees responsible
- Users are encouraged to discuss results with EHS.
- JHA initiation and reassessment is conducted as part of change management process.
- For identified health exposures, subsequent exposure monitoring is conducted.
- Continuing to gain experience and adjust as needed.

LESSONS LEARNED



- 'Goldilocks Syndrome' when listing job tasks: just right!
- Uncertainty is inherent - define terms objectively.
- Plan in advance what is covered and order of execution.

Building:				Dep	artment:				
Job/	Task or Eq	uipment N	ame	Room # (ir	f applicable)	SOP # (if a	applicable)	Complete	d Date

LESSONS LEARNED – CONT.

- Discuss with customers in advance how they'll use the information and where to keep.
- Train and involve the operators they're the experts.
- Make sure to include unusual, non-routine steps!
- Build an EHS review 'chokepoint' into the process to avoid substandard products.
- Very useful during incident investigations.
- Discuss in advance how to keep them fresh.

BAYER'S EXPERIENCE

- Learning curve calibration and hazard vs root cause.
- Customer experience to date has been positive.
- Allows non-experts to quickly review exposure risks of new operations.
- Provides a transparent method of control recommendation.
- Facility-wide evaluation allows prioritization of risks.

CAUTIONS

- User training is essential.
- Balancing uncertainty with effectiveness. Only suitable for entry level risk assessment.
- How risk assessment parameters are defined is critical.
- Not appropriate for "special" circumstances (e.g., spills, open spraying, pregnancy, synergism, etc).
- Must be an element of holistic management process.

SUMMARY

- Compliance may not achieve value / performance.
- JHA's using risk assessment matrices can be an effective way to prioritize and mitigate risk.
- Bayer's efforts successfully prioritize risk levels and meets business challenges.
- Additional refinement is ongoing.

THANK YOU

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